

# Tertiary beam performance, preliminary analysis

Most data and conclusions are based on  
“Run 7” on 25 January 2010, 6 hours.  
or all 16 GeV data on 25 January, 12 hours.

We've analyzed  
event rate, trigger purity, and sample reduction  
time of flight performance  
very preliminary momentum spectrum

We have a list of modifications to make,  
and have a good handle on the  
beam configurations  
we will want going forward.

# We sorta-purposely took an impure trigger

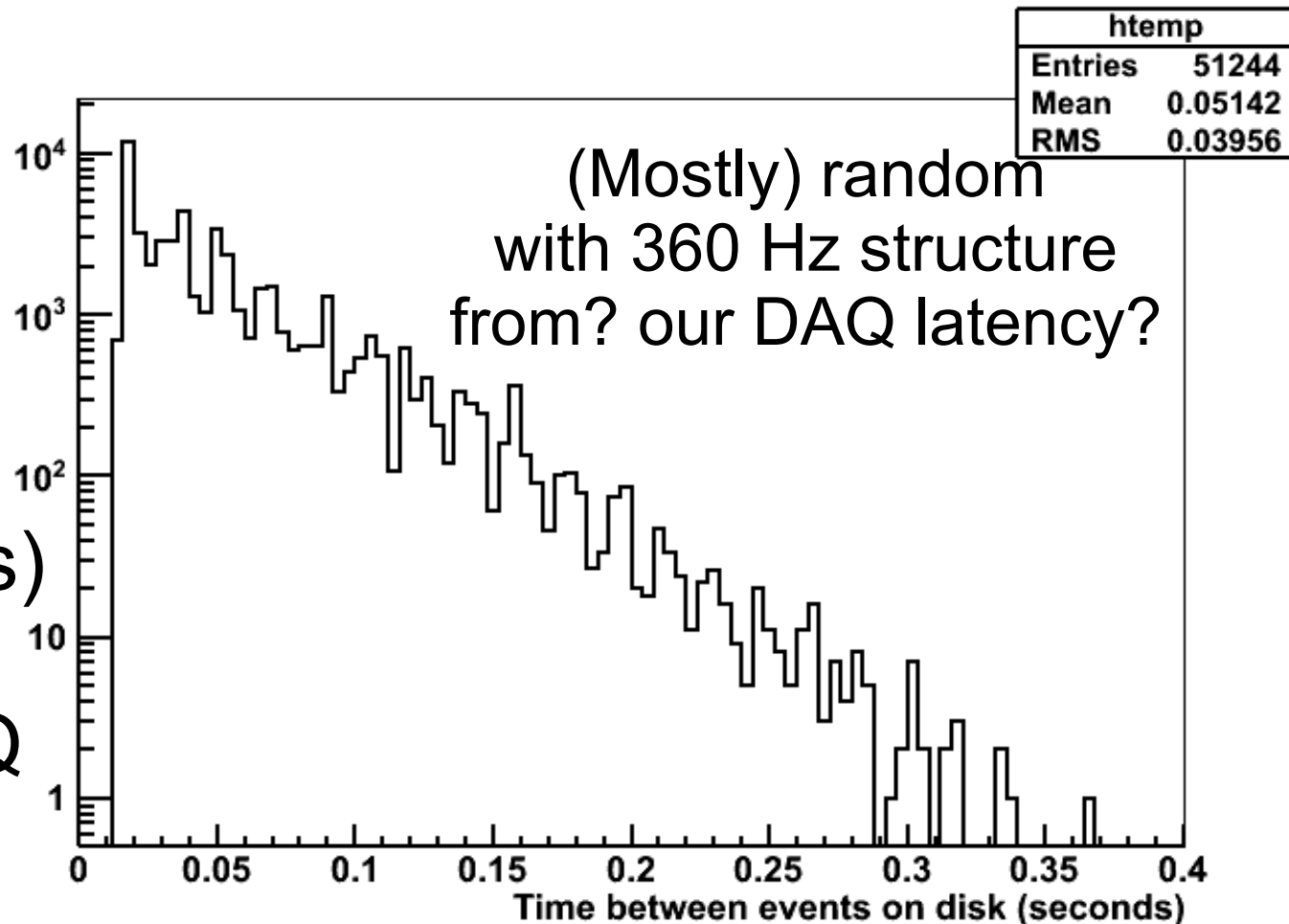
How bad was it? Not so bad.

Our raw hardware trigger rate was probably  $\sim 30$  Hz  
upstream TOF, downstream TOF, and scintillator at WC3

Beamline DAQ  
rate 20 Hz.

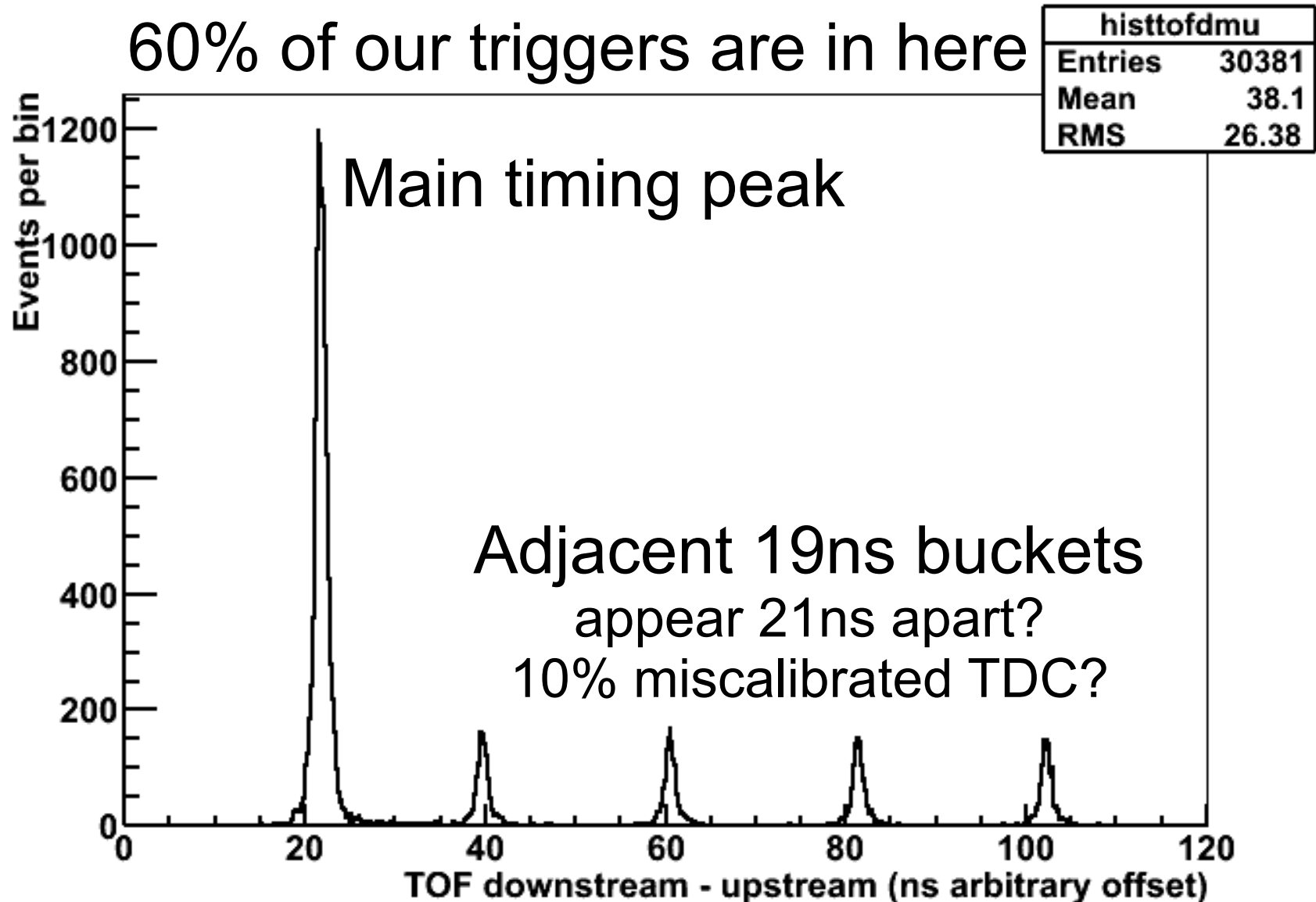
Max beamline DAQ  
50 Hz.  
(readout time 20 ms)

Max MINERvA DAQ  
probably 20 Hz.



# Time of flight distribution, no wire chamber info

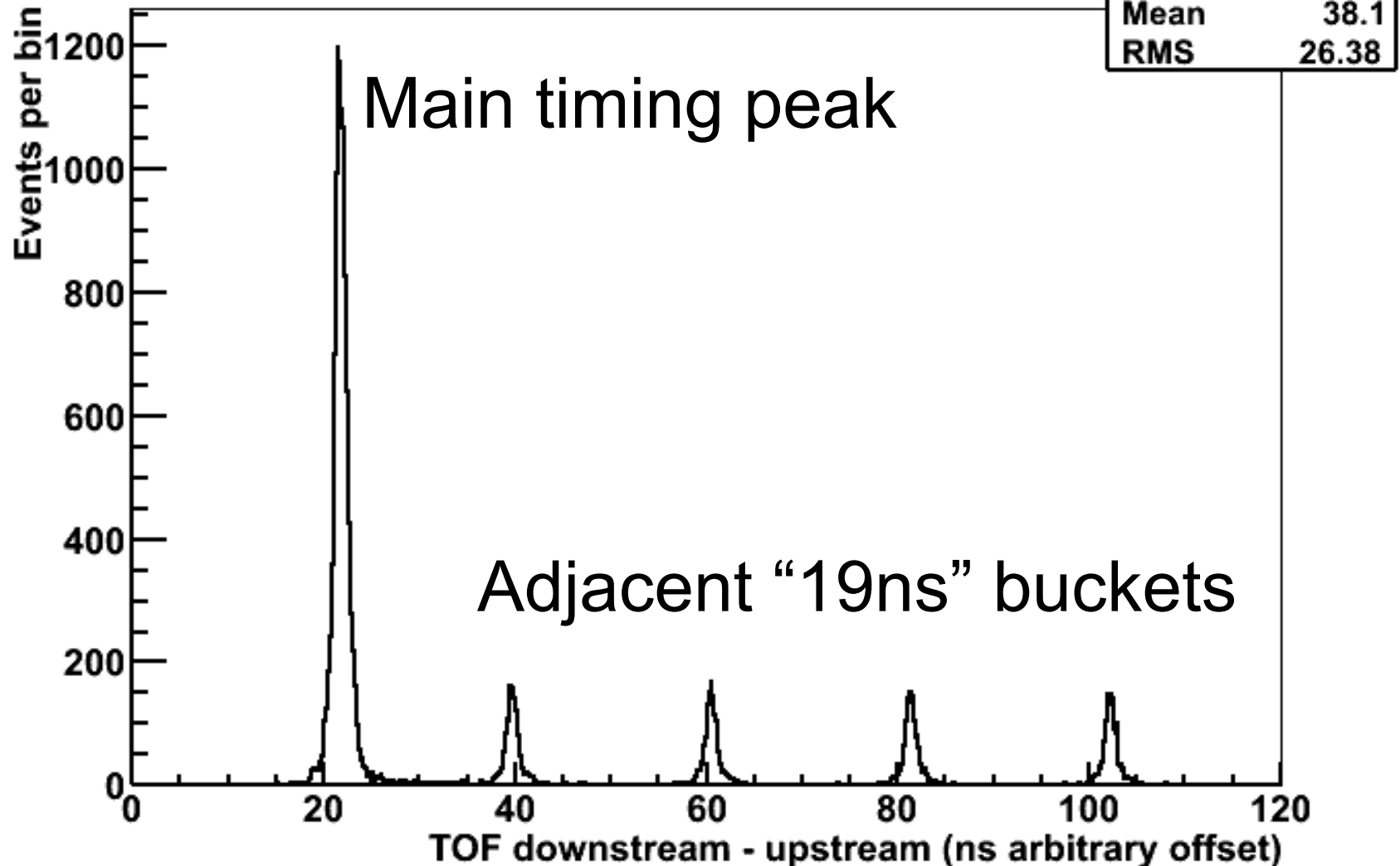
60% of our triggers are in here



Other 40% triggers are not visible off to the right or left.  
The gate widths in the trigger are a bit wider than needed,  
will adjust them and reduce 40% impure to ~20%

# Time of flight distribution, no wire chamber info

Still thinking trigger purity here



The adjacent bucket accidentals are about 40% of total.  
We ran 20 buckets per turn? Move to full 60 buckets/turn,  
but then increase particles on target by x3 to 300k/spill

## More effort to purify trigger

My goal is to go back to running 300k POT (not 100k)  
But we're at the MINERvA DAQ limit,  
so need to keep working to purify trigger also.

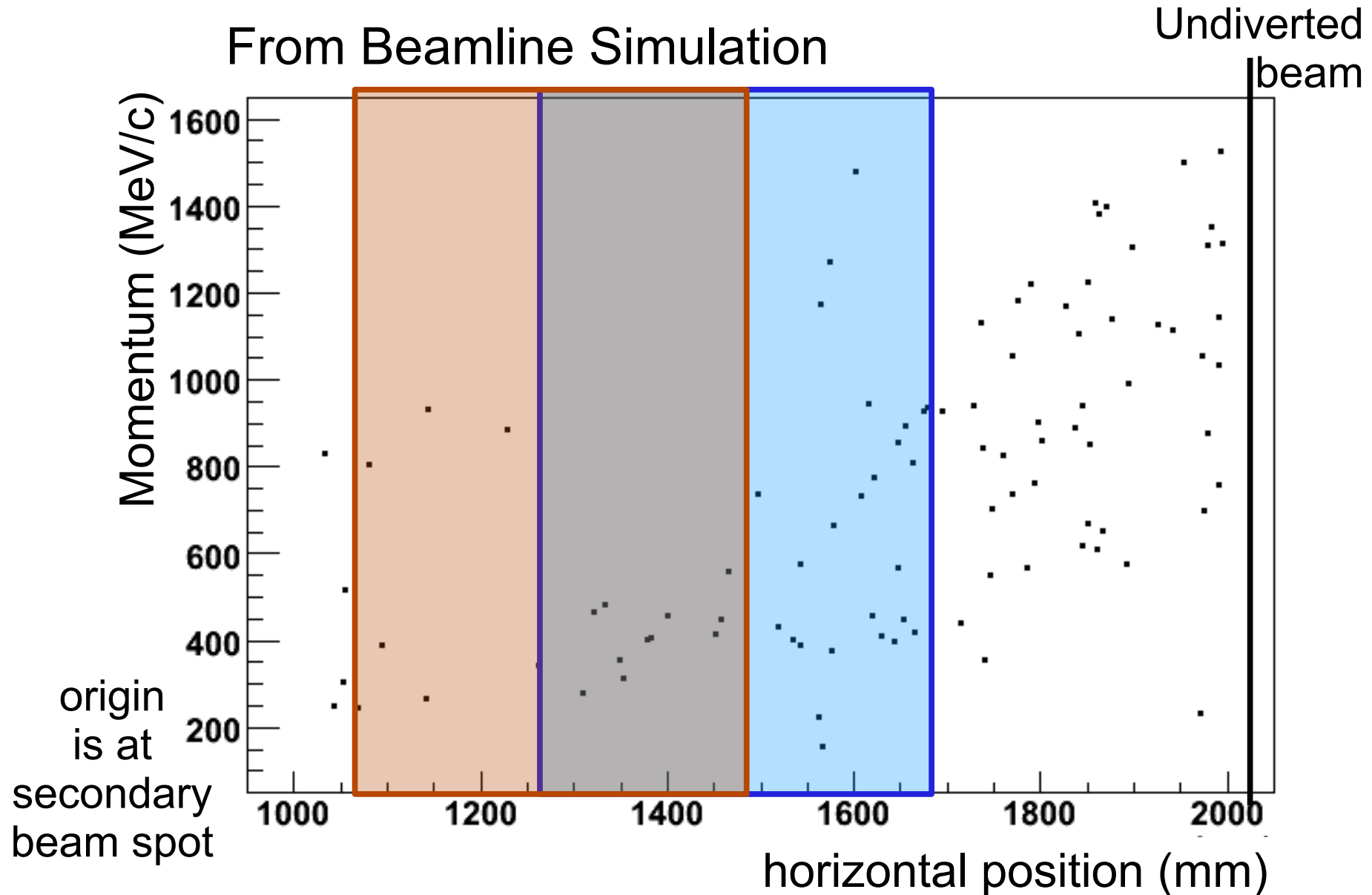
Of the triggers on the TOF distribution,  
many did not populate all the wire chambers.

The Wire Chamber discriminators have a “fast-sum”  
which we tested in January in software. This helps.

Using it on WC1 alone would reduce the trigger rate  
in HALF, with very little loss of efficiency (93%).

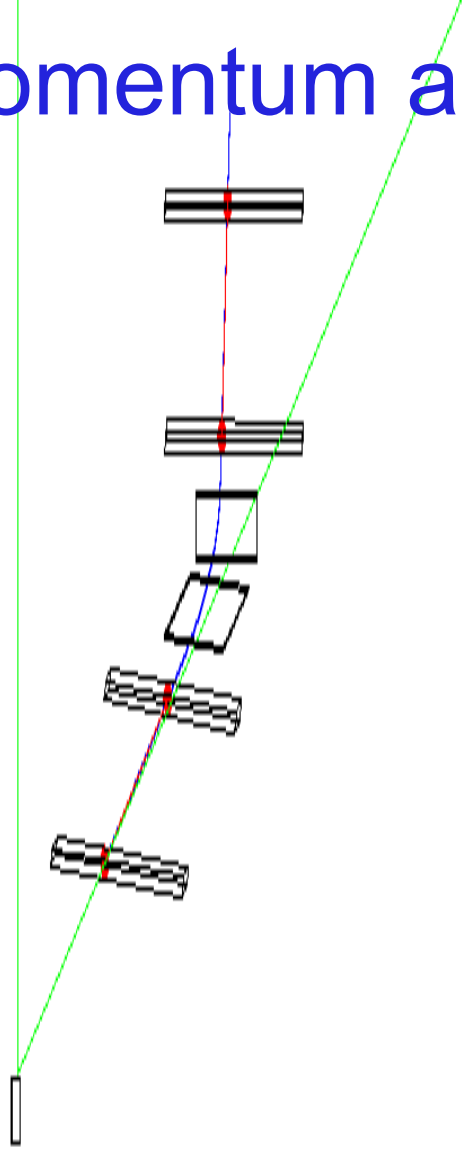
Next: implement it in hardware for all four chambers.

# We put WC4 too far West!



We lost track of what Carlos said our simulation said. Gain ~2 in signal with this move 6" to the east (blue).

# Momentum analysis – Very Preliminary



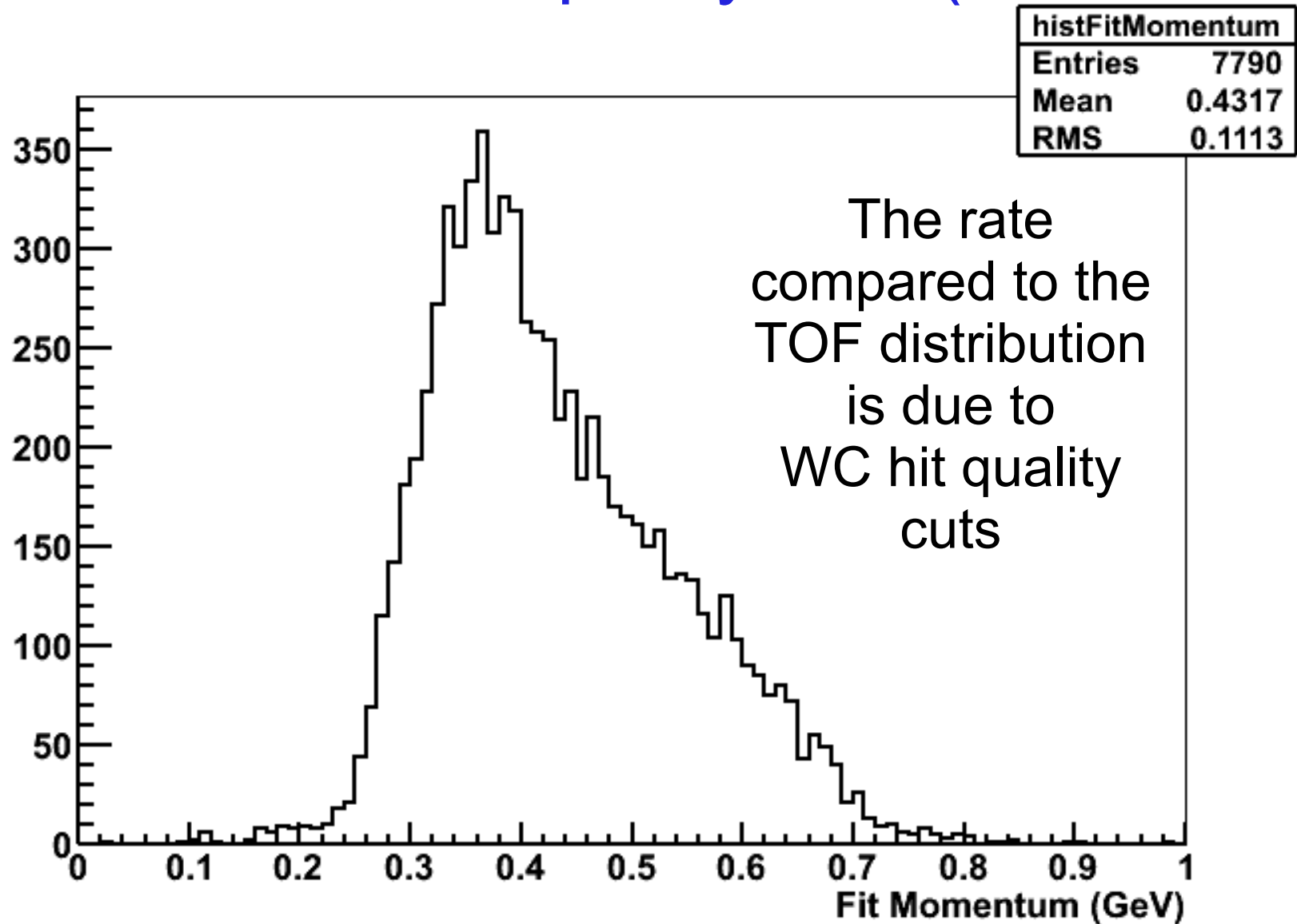
Visualization of fit path  
fitter & stepper code  
by Lee Patrick.

As-found survey  
Simplified B-field model  
Quality cuts on WC hits.

Minuit2 fitter via Root fitting  
initial  $dx/dz$ ,  $dy/dz$ , initial  $p$   
Runge-Kutta stepper.

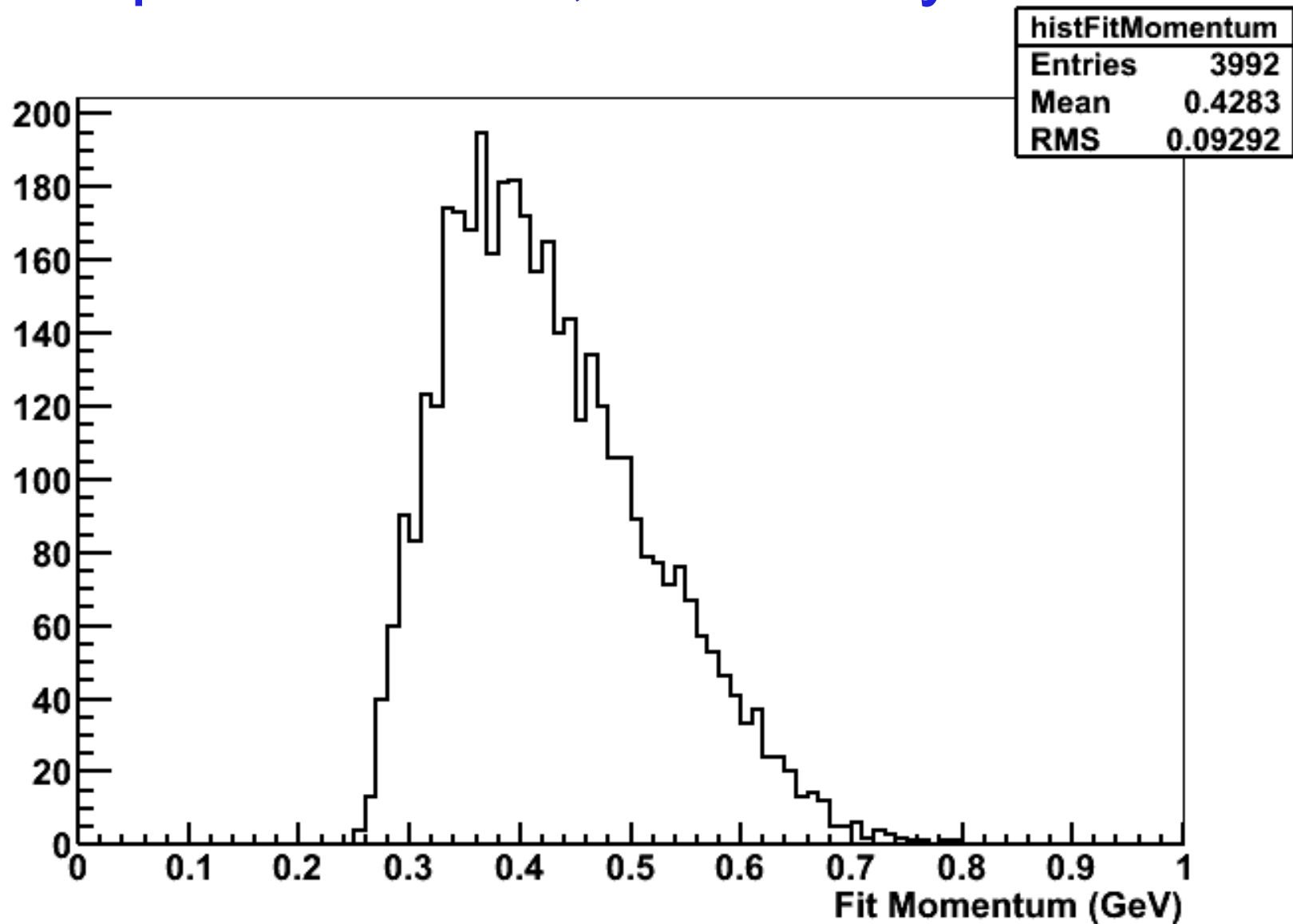
Simplified B-field model  
still working on final model.  
principal component  
yes simple fringe field  
no transverse variation  
Bdl 5% to 10% too low.

# Output of the fits, no quality cuts (but tail cut off)



But remember, with a  $15^\circ$  bend angle, all fits have to be in this range, signal and noise alike.

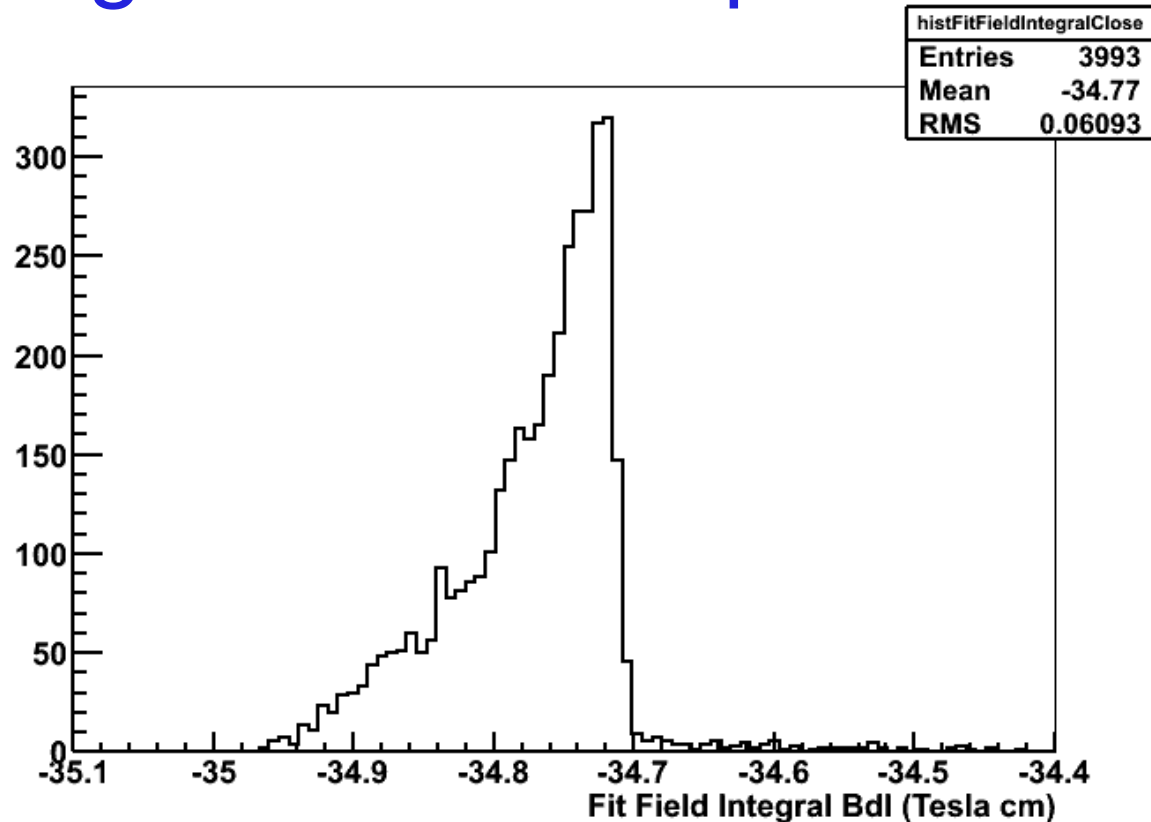
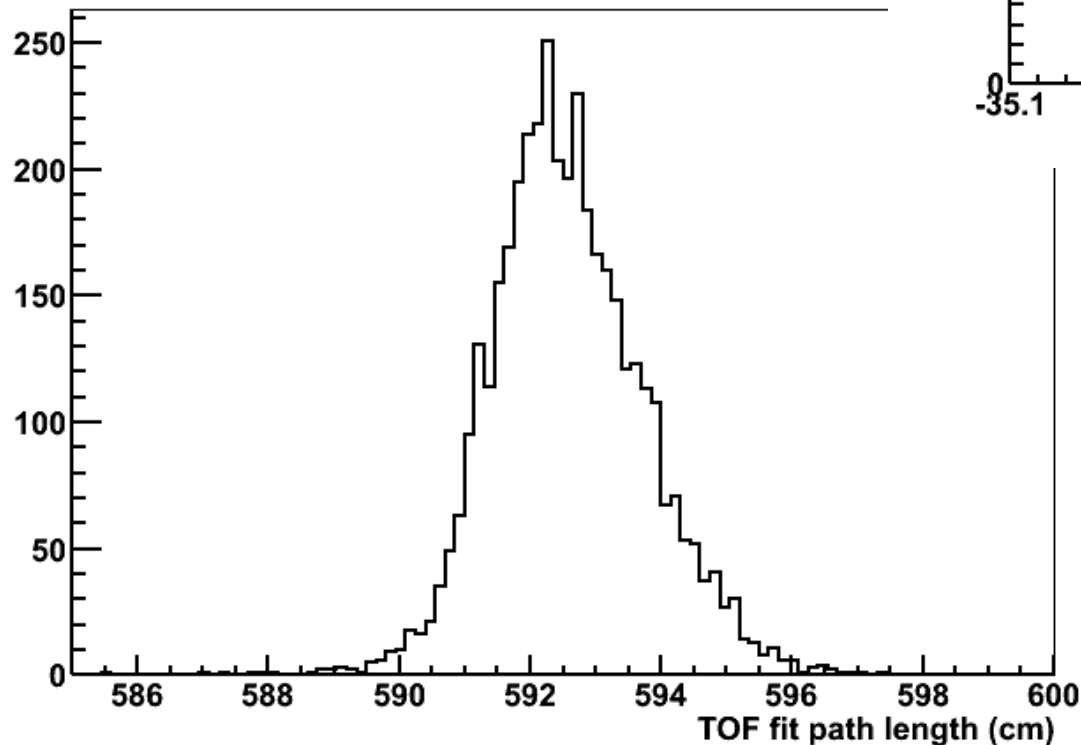
# Output of the fits, Minuit says valid fit



Okay, now we're closing in on something I'll believe in.

# What the fit is telling us about the path

Most of these  
“Valid fits”  
go right through  
the magnets



These are the size of the  
geometrical variations.

RMS of 1.16 cm  
is 40ps at speed of light

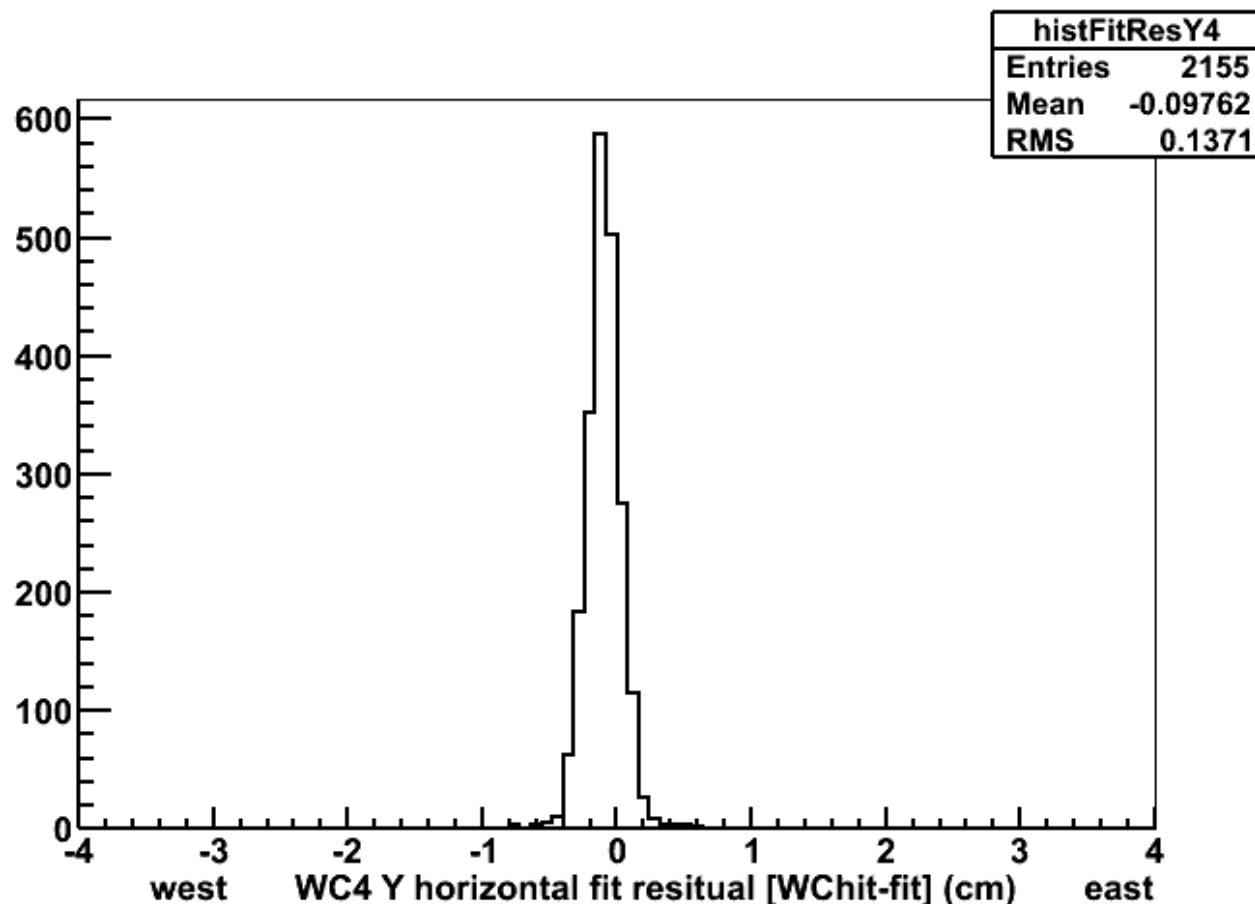
Add a WC fiducial cut, look more carefully.

New fiducial cut:  
go ~1cm inside  
inside magnet  
apertures.

WC4 horizontal  
fit residuals  
RMS 1.4 mm.

WC3 is worse,  
RMS 4 mm.

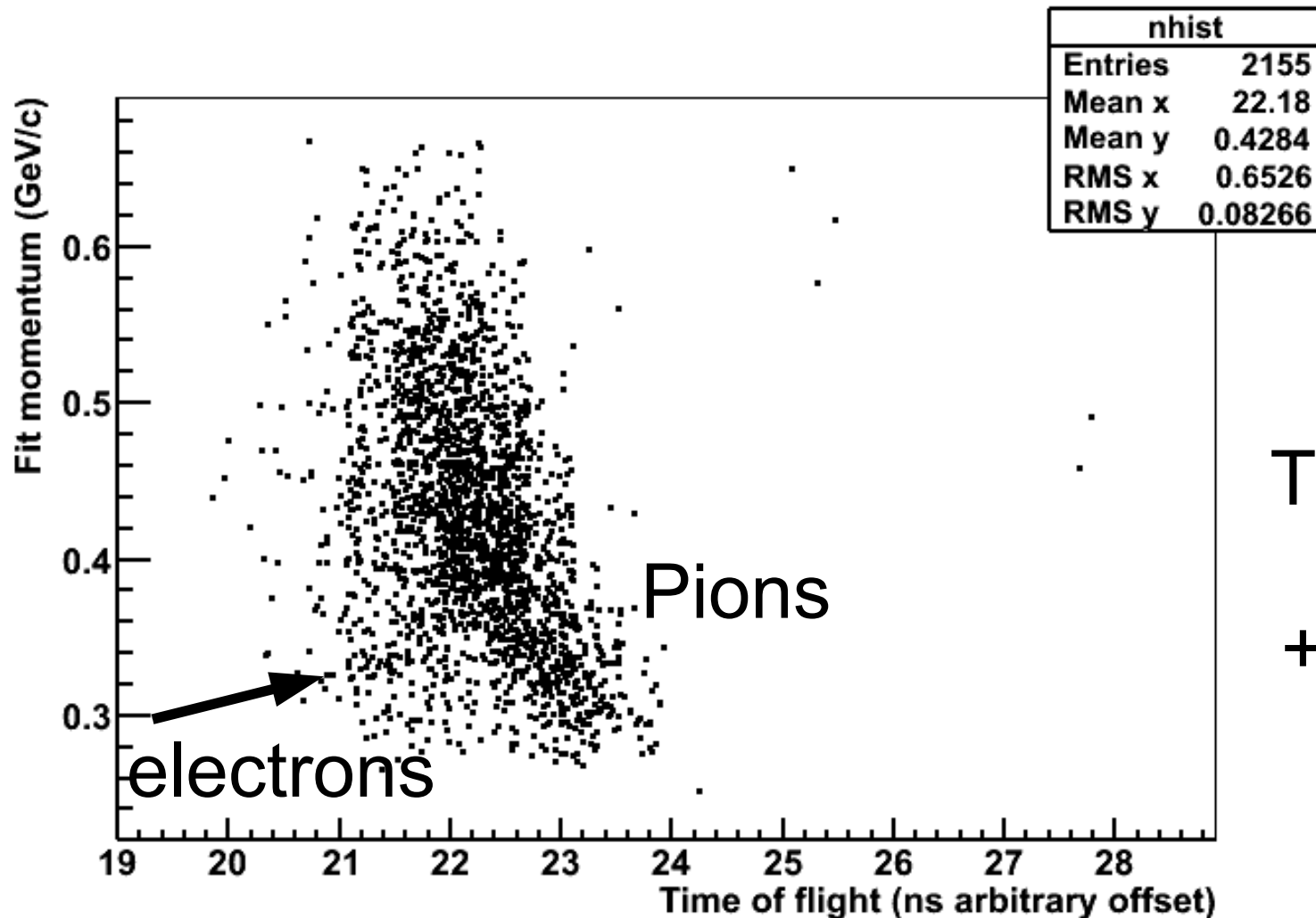
Very preliminary,  
ongoing study...



Combination of  
too-simple field model (improvable)  
and multiple scattering (modelable)

At 400 MeV/c, implies  $dp/p \sim 0.07$

# Momentum vs. time of flight



Selection:  
Valid TOF +  
TOF peak only  
+ Valid Fit  
+ Fiducial WC

Concern that TOF resolution is  $\sim 400\text{ps}$ , not  $\sim 200\text{ps}$ ,  
the high momentum and electrons TOF are too wide.

# Conclusions

Some relatively easy improvements to trigger purity  
Move WC4 to the east 6 inches  
Increase beam POT request by increasing buckets

TOF resolution seems too wide.

WC data looks basically okay,  
but a lot of detailed work still ahead  
to understand biases and resolutions.